

Prioritizing Risk Trees in a Community

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Tree wardens, community arborists and urban foresters are responsible for maintaining park and street trees that are safe from problems that could lead to property damage or injury. The literature offers a general consensus about what makes a tree hazardous and how to rectify the risks once identified. Without exception, published references agree that a hazard tree must contain both a structural flaw – which could cause the tree, or part thereof, to fail – and a target of some value. In addition, a tree may be a hazard if it stands in an environment that might contribute to the potential for failure. Examples would be sites that are prone to high wind or wet soils.

Another problem that tree wardens must consider when inspecting for risk trees are trees planted too close to street signs, traffic lights, or street lighting, because branches obscuring such signs or lights could lead to traffic accidents or personal injury. Trees in urban and suburban areas can also create hazards to pedestrian and vehicular traffic with low branches that block sidewalks or streets. The minimum street clearance for thoroughfares is 14 feet. This is enough to allow standard-sized tractor-trailers to pass without encumbrance. Sidewalk clearance is most often on the order of 10 feet. Nevertheless, one can walk or drive through many neighborhoods, urban and rural, and

The weak crotch is all too common along our public streets and in some locations is the No. 1 reason for a tree failing. Early identification and correction is required.



A large street tree that had the roots cut by the town during a road widening project. A 15-minute thunderstorm in August toppled the tree and nine others on this Long Island, N.Y. street.

find streets and sidewalks without the specified clearances.

Trees can also present a hazard in community settings with their roots. Planted too close to sidewalks and curbs, trees may grow roots that can interfere with adjacent physical infrastructure. Tree roots search-

ing for oxygen, water, and nutrients will upset concrete sidewalk slabs quite easily. This is especially obvious when trees are planted in the utility strip, where soil conditions are frequently poor. In search of better growing conditions, tree roots travel under the sidewalk to nearby residential

lawns. Over time, the roots grow in diameter and lift up the sidewalk, creating a trip hazard. Given our culture's current fondness for litigation, such a trip hazard has the potential to result in a large lawsuit.

A final hazard that trees present to communities deals with utility lines, above and below ground. Utilities across the country spend over \$1 million per day clearing power lines along roadways. In spite of this, power failures often occur as the result of tree-related damage. Here again, the trees are presenting a problem that is not necessarily the same as a hazard tree structural failure. In severe weather, even structurally sound trees are apt to fail. From this introduction, it should be clear that every community needs to prioritize its tree risk potential in a systematic way.

Community Tree Management Program

It is essential that a community's tree risk management program be systematic. This point cannot be overemphasized. In a court of law, a plaintiff must prove negligence on the defendant's part in order to win a lawsuit. Negligence arises from:

1. the responsibility to maintain safe trees in the community;
2. a subsequent breach of that responsibility, such as when a hazard tree is not removed;
3. damage or injury resulting from the breach of responsibility. For example, if the hazard tree failed and damaged a car.

In many instances, it is impossible for a municipality to remove all the potentially hazardous trees in its streets and parks. It therefore must abide by the reasonable person standard. The standard is used to judge if an action was reasonable and prudent. In other words, would a reasonable person, given the same situation, have behaved similarly? The best way for a community to obey the reasonable person standard is to develop a written, systematic procedure for locating and evaluating potentially risky trees. Because it is not feasible for a community with limited financial and personnel resources to remove every potentially hazardous tree, having a systematic procedure, in writing,

is the best defense against negligence. The procedure should detail a rating system that prioritizes trees based on their risk of failure and potential to cause damage. The procedure should also provide a standard timeframe for inspecting, on some level, the community's trees.

Inspection Cycle

It is reasonable for a community to inspect their street trees annually (park trees and open space trees are not included here, because their target ratings are usually less than for street trees). The extent of the inspection will vary, given available resources, but some form of inspection should occur annually. For



This large hanger in a sugar maple over a park bench was on a heavily used public common in New England for over three months before it was removed by the town!

many cities, this might be purely a windshield survey, where the urban forester drives each city street in the course of a year and looks for major and obvious defects in trees. As long as the procedure is standardized, systematic, and established in writing, a municipality can justify this inspection system given a limited budget. With adequate funding

and labor, towns can undertake more intensive surveys, spending more inspection time on each tree. It's important that – at a minimum – every tree be inspected using the visual windshield survey method. One exception is trees in low priority areas. After undertaking an initial hazard tree inventory, the urban forester can de-prioritize areas of the community where target risk is so low that tree failure is extremely unlikely to cause damage. If it is reasonable to do so, surveying high-risk areas, like a downtown business district, should occur more frequently than undeveloped nature areas. This is reasonable prioritizing, designed to reduce tree risk. This type of prioritization has been implemented for recreation and park areas and is also useful in a community setting.

Inspection Process

An evaluator must inspect each part of the tree, crown, stem, and roots, especially if root damage is suspected. The tree should be viewed from all sides, although a windshield survey might miss something on the side of the tree facing away from the road. The inspector should proceed in the inspection in the same manner each time in order to achieve a pattern of investigation that will help make comparisons to other trees and defects.

The next section introduces crown, stem and root defects that are common to municipal trees. Municipalities that do not have qualified arborists on staff who can perform this type of tree inspection should contract with a consulting arborist to do the inspection each year. A list of commercial arborists is available from the National Arborist Association at 800-733-2622 or www.natlarb.com.

In the crown, the inspector looks for problems with the branches. These can come in the form of broken, hanging branches; cracked branches; branches with significant decay or cavities; or dead branches. It is recommended that a threshold for defective branch size be established, generally around two inches in diameter (conforming to the ANSI A300 pruning standard for crown cleaning).



Basal decay on a street tree. At what point do you remove the tree?

Smaller defective branches may be present, but do not present a hazard risk. Weak branch crotches are also a common defect in street trees. Depending on the size of the branches involved, the stress on the crotch can be severe. In a recent survey of New England arborists and tree wardens, most respondents listed weak crotches and decay in the top three most common tree defects.

Weak crotches are a leading cause of branch and whole tree failure. They can be found not only between the stem and a lateral branch, but also between co-dominant leaders in a decurrent tree. Because tight, "V-shaped" crotches with included bark have little sound wood holding the branches together, they are more likely to fail when subjected to wind stress or snow load. In fact, as the branches continue to increase in girth, if annual rings cannot envelop both branches, the included bark acts like a plate preventing the stems from supporting one another. Eventually, the respective girths push each other apart enough to cause cracking or failure. Visually, included bark appears as a disappearance of the branch bark ridge one normally detects between stem and branch. It appears as if the branch bark ridge has been pulled back into the branch/stem union.

Stem and branch defects are commonly associated with wounds that lead to decay and open cavities. Cankers and cracks, common in park settings, are less

of a problem for street trees. Vehicular contact and vandalism are more likely causes of wounds on street trees. Again, certain decay thresholds need to be established, such as the 30 percent strength loss limit for considering a tree hazardous. With decay, trees can be up to 70 percent hollow before they approach the 30 percent strength loss threshold. With cavities, trees can have an open cavity between one-third and one-half of the stem circumference before reaching the 30 percent strength loss threshold.

As a tree defect, wood decay has received close scrutiny. Decay is common on tree trunks, branches and roots because any time bark ruptures the decay process can proceed. Dr. Walter Shortle of the USDA Forest Service called decay in living trees the most damaging disease for all species around the world. Dr. Thomas Smiley and Dr. Bruce Fraedrich of the Bartlett Tree Expert Company have published that they consider decay to be the most common hazardous defect of urban trees. Decay undermines wood strength properties. Each tree warden needs to determine just how much decay the community is willing to live with, since there is no national standard at this time.

In the root zone, the tree warden should look for cut roots, decay on the root crown, soil heaving or root plate lifting, and fruiting bodies in the soil indicative of root rot fungi. Trees that have lost up to one-half of their root sys-

tems should be considered hazardous. Sometimes root crown investigations are insufficient, and the inspector must excavate around the root crown to look more closely at the buttress roots. Trees without a root flare (they appear to go into the ground like a telephone pole) must be carefully evaluated below the ground, since root flare defects might have been hidden by the excess soil piled around them.

Ultimately responsible for a tree's structural stability, the roots also provide water and dissolved minerals from the soil. Large, woody roots offer support and anchor the tree; tiny root hairs and mycorrhizae absorb nutrients and water in the soil. Root damage or loss accounts for a large percentage of tree deaths and failures. Through a variety of injuries caused by construction, installations of irrigation systems, improper drainage, and soil compaction, roots can sustain exorbitant amounts of damage. Often, root injuries are covered with grass, fill, or concrete and this successfully hides the severity of the damage. This creates an especially dangerous situation since a casual tree examination can easily overlook the root system. Symptoms of root damage are manifested in the crown by poor growth, thinning and chlorosis of the foliage, as well as a general decline starting from the top of the tree. Other visible signs of root damage include bleeding wounds on the trunk; loose, peeling bark around the stem buttress; sunken areas around the lower stem and buttress; girdling roots and adventitious roots growing above the root flare, and cracks extending into the stem from the soil line. Any time an inspector notices recent roadwork, landscaping, irrigation system installation, or paving near a tree, they should inspect the root system for potential damage.

A final flaw to look for is the presence of a lean. Trees will lean as a result of various external forces. Competing for light or in reaction to prevailing winds, some trees naturally lean away from others. Leaning trees reacting to natural forces have built up reaction wood to compensate for the lean; this is not a hazardous situation. When trees show signs of leaning, but have gradually straightened up over time, this too is usually not a hazard-

ous situation. These trees leaned due to a past impetus, but by straightening, they have regained apical dominance and, in most cases, will ultimately balance the crown. In scenarios where trees are unnaturally leaning, however, a hazard results. Poor soil conditions, mounding and cracking of the soil behind the leaning tree, and exposed roots protruding from the soil all manifest an unnatural lean, where the tree is in danger of completely falling over.

In addition to the structural defects listed above, the tree species is a closing element to consider when determining a tree's hazard potential. Different species have different wood characteristics. Oaks generally have strong wood, which is less likely to fail than a tree with weak wood, such as willow. Because of this, similar defects on different tree species will not necessarily represent similar risk. Different species also have varying abilities to compartmentalize wounds. Certain species are prone to forming poor branch attachments, such as silver maple and American beech. Some are less likely to fail than others. The inspector must be knowledgeable regarding local trees and their growth habits.

Assessment System

Given all the data an inspector would collect from the defects listed above, it is imperative that a priority rating system be used in order to develop a risk-management strategy for a community's trees. This way, the inspector can assign numerical rating values to each defect and target. For example, a simple rating system would rank defects in terms of their likelihood to cause failure: a rating of 1 means low failure probability; a rating of 3 means high failure probability. Next, the inspector ranks the size of the defective part: a rating of 1 indicates a small defective part (between 2 and 5 inches diameter); a rating of 3 indicates a large defective part (greater than 10 inches diameter). The inspector then evaluates the target from two perspectives – the likelihood of it being damaged if a failure occurred and the amount of damage likely to be incurred from a failure. Lastly the inspector would take into consideration the tree species. These variables would also be ranked 1 through 3, with 1 indicating a low damage prob-

ability and small amount of damage and 3 indicating a high probability of damage and a large amount of damage occurring. When totaled, the numerical values would fall between 3 and 12, lending an idea of the hazard priority of each tree. Using this rating system, a community will have identified problem trees and have them ranked by number. The tree warden could then start work on the trees highest ranked, reducing a municipality's potential liability.

Assessment systems can be as detailed or simple as preferred. Simple systems that account for fewer variables are less powerful for analysis and prediction, but would require less time and effort on the inspector's part. Currently, there are several forms for ranking trees being used by arborists. The International Society of Arboriculture has published a reference book on hazard trees, and the park agencies of California and Minnesota have been using a system designed for their parks for many years.

The Community Tree Evaluation Form that is attached to this article was first developed by Jill Pokomy of the USDA Forest Service St. Paul, Minn. It has been modified by the authors over the last three years with input from the New York State Department of Environmental Conservation, the Massachusetts Department of Environmental Management and the Massachusetts Tree Wardens and Foresters Association. The intention was to give tree wardens and community foresters an easy-to-use and cost-effective tool designed for the efficient evaluation of street trees.

Corrective Action

Identifying hazard trees and then ignoring them undermines the original intent of performing the evaluation. Managers should establish hazard tree correction measures based on thresholds from the rating system. In other words, numerical or verbal ratings should correspond to a given remedial action to mitigate the problem. Corrective treatments, pruning, cabling, tree removal, moving the target, augmenting tree vigor, and excluding visitors from hazardous sites are some of the options. Astute tree managers will explore all possible ramifications of any corrective

action. Community opposition to removals will vary, so an urban forester must be willing to explore different options for hazard reduction.

Corrective actions depend on what part of the tree is likely to fail, how likely it is to fail, and what special significance the tree might hold. Despite being hazardous, certain trees demand preservation efforts because of their historical, cultural or physical significance. An excellent example is the Balmville Tree in Orange County, New York. Although most consulting arborists agreed the tree was hazardous, residents of the community expended considerable effort and financial backing to preserve the tree because of its historical significance. In many cases, hazard tree correction can be as simple as moving playground equipment.

Conclusion

Some communities are under the impression that if they don't know about a hazard tree, then they are not responsible when it fails. Nothing could be further from the truth. In a 1994 court case in Connecticut, for example, Judge Anne C. Dranginis ruled that "all property owners – state and private, city and rural – have the legal obligation to inspect their road or streetside trees for age, condition or weakness that might make them a hazard to passersby."

The key to a community's tree inspection and maintenance program, then, is to establish a systematic protocol for assessing the community's trees. The procedure should be formalized in writing and should contain methods for assigning values for tree defect severity, size of defective part, target value, and probability of defective part damaging a target. This is the most efficient way to manage hazard trees and reduce a community's exposure to liability from a tree failure.

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Community Tree Evaluation Form

Location: _____ Date: _____ Inspector(s): _____

Tree #	Sp.	DBH	Location Information Examples: Street address, GPS, Map/GIS	Probability of Target Impact (1-3 points)	Size of Defective Part(s) (1-4 points)	Probability of Failure (1-3 points)	Species Rating (0-2 points)	Hazard Rating Sum of last four columns	Action Recommended	Action Completed	
										Date	Initials

PROBABILITY OF TARGET IMPACT: 1-3 points

- Occasional Use:**
 - Low use roadways (i.e. dead end roads, turnarounds, etc); low-use recreation trails; woods and open space with low foot traffic.
- Intermittent Use:**
 - Roadway intersections in high use areas; parking lots adjacent to moderate-low use areas; dispersed picnic areas; collector streets and minor arterial roadways
- Frequent Use:**
 - High use park and play areas; all buildings and residences; schoolyards; specially marked handicap-access areas; and parking lots; adjacent to high use areas; principal arterial roadways, freeways and expressways.

SIZE OF DEFECTIVE PART (S): 1-4 points

- Parts less than **2** inches in diameter
- Parts from **2 to 10** inches in diameter
- Parts from **10 to 20** inches in diameter
- Parts **greater than 20** inches in diameter

PROBABILITY OF FAILURE: 1-3 points

- Low:** some minor defects present - minor branch dieback; minor defects or wounds
- Moderate:** one to several moderate defects present - stem decay or cavity within safe shell decay; hardwood stem with single crack and some decay; weak union with inrolled bark, defects(s) affecting < 1/2 tree's circumference; leaning tree (away from target area, <45 degree angle), without recent root lifting or soil mounding
- High:** multiple or significant defects present - stem decay or cavity at shell safety limits; multiple cracks or a single crack which goes completely through the stem, weak union with crack or decay; defect(s) affecting > 1/2 tree's circumference, with decay present, leaning tree (toward target area; <45 degree angle) with recent root lifting or soil mounding; recent construction, dead or lodged branches; dead trees

SPECIES RATING: 0-2 points

- Durable Species-** Not Prone to Failure (ex. Red Oak, Sugar Maple, etc.)
- Average Species-** Moderate Strength
- Weak Species/Dead Trees-** Prone To Failure (ex. Poplar, Willow, White Pine, etc.)